

IN THE SPECIFICATION

Please amend paragraphs 001, 0010, 0077, 0080, 0099 and 0114 of the application, as filed, as follows:

[001] This application references Provisional Application No. 60/253.799 filed 11/29/00; of Ken Cowans titled, "High efficiency engine with variable compression ratio and charge; (VCRC engine)". This application is a division of application No. 09/995,674, filed November 29, 2001.

[0010] Current proposals mostly fail to globally address the complexity of this problem. Any solution that addresses internal combustion engine efficiency needs to consider the basic combustion process itself. To obtain high efficiency at very low power outputs a solution must address the problem of lean burning. Hydrocarbon fuels do not burn rapidly enough for use in an automotive sized engine at fuel-air ratios under around 50-60% of stoichiometric ratio. To obtain ultra-efficient burning at 10% of maximum power output it is necessary to efficiently combine the fuel with air at fuel air ratios around 15-20% of stoichiometric within the time it takes an engine to rotate 30-35[0]° at around 2,000 rpm or about 3 milliseconds. No matter what is done to a bulk air-fuel mixture this has not proved feasible in workable systems.

[0077] Referring again to FIG. 1 and FIG. 4: The VCRC engine at idle uses only gas passage 54 for a combustion space. In this mode of VCRC operation slide 6[5]6 is moved through operation of control rod 68 so that auxiliary piston 57 nominally cannot move from its position closing combustion chamber 56. In this position auxiliary piston 57 closes off the volume in combustion chamber 56 so that the combustion chamber volume is nominally zero. During idle the engine needs a small amount of torque to run the engine's accessories and any other devices such as air conditioners and power steering pumps. The amount of fuel needed to support the energy required is fed in through injector nozzle 56 in a carefully timed manner. By regulating the time that the fuel flow starts and stops a temporary boundary between fuel rich and fuel absent air exists in air passage 54 during a compression stroke. The fuel rich volume will be bounded by auxiliary piston 57 at one end and at a position in air passage 54 at the other. Spark plug 55 is located at the end of air passage 54 near auxiliary piston 57 so that the mixture will burn upon firing of the spark plug. During idle throttle control is only present in the timing of the fuel injection: The compression ratio during idle mode is substantially constant. Although auxiliary piston 57 is nominally immobile during idle the compliance of all the parts in the assembly holding auxiliary piston 57 against gas pressure within the engine's working volume will allow piston 57 to undergo a small oscillatory motion that will keep the surface between piston 57 and cylinder 117 lubricated.

[0080] Lever 68 is connected to the throttle controller for the engine system. Lever 68 is also connected to the fuel injection system. The connections amongst the elements of throttle, lever 68 and fuel injection system [is] are not shown in FIG. 1. One possible mechanical schematic that connects compression ratio control, fuel feed control and speed interaction control is shown in FIG. 13. The control relationship of throttle, compression ratio, speed and fuel feed is described in FIG. 2. A movement of the control towards increased torque demand is accompanied by a control for lowered compression ratio as well as for increased fuel flow. The simultaneity of these three commands and the organization within which they are linked provides the engine that uses the inventive concept with a potential for an efficiency of heat energy conversion to mechanical work higher than has been reached before in those sizes of prime mover used for transportation applications. This type of control mechanism could be reduced to practice using many types of conventional devices.

[0099] The position of the central pivot point 160 of gear[l] 29 will change the relationship between amount of fuel supplied and the compression ratio of the engine. As pivot point 160 moves away from fuel pump controller 135 a given amount of fuel supplied to the engine will result in a lower compression ratio. A servo motor 132 suitably designed for the task is positioned as shown in FIG. 13. A signal to servo motor 132 will position pivot point 160 to effect a suitable balance between compression ratio and fuel supplied. As speed increases pivot point 160 will be positioned closer to fuel

pump controller 135 so as to effect a higher compression ratio for a given amount of fuel supplied for each engine cycle. This will increase efficiency as speed increases as noted in the section on control of the system discussed previously.

[0114] There are two basic problems with the two stroke engine as an efficient prime mover. The most basic is the throttling problem. Two-stroke spark engines are most often regulated by restricting the input fuel-air mixture since they are normally fed a bulk carbureted mixture of gasoline and air. The effect of this restricting is only to retain exhaust products in the cylinder volume. Thus the efficiency is good at full throttle, limited only by the air breathing problem discussed before. At part throttle, however, the efficiency is much worse than the four-stroke equivalent. This is one of the main factors that has limited the usage of spark-ignition two-stroke engines.